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ABSTRACT

The first section of this report on program costing with the CAMPUS simulation discusses the structuring process of Program Planning and Budgeting (PPB) systems, and emphasizes the ideas, rules, and principles for structuring resource data that have evolved during the 10 years of PPB existence. It also discusses the WICHE-PMS program classification structure that has been developed to provide a consistent means of identifying and organizing the activities of higher education in a program-oriented manner. The basic issue revolves around whether the grouping of an institution's activities (particularly those related to instruction) into discipline divisions and discipline specialties is a more appropriate output-oriented format than grouping the activities by degrees. The second section: Program Costing and the CAMPUS model describes 4 procedures to handle the conversion of resources from the CAMPUS-V model, and where the resources are developed for departments to an output-oriented format. The 4 processes are: (1) service department process; (2) activity/curriculum process; (3) nonteaching duty process; and academic indirect resources process. (AF)

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Project PRIME Report No. 5

PROGRAM COSTING WITH THE CAMPUS SIMULATION MODEL

by

David C. Cordes

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PROGRAM COSTING
WITH THE CAMPUS SIMULATION MODEL

Other Project PRIME reports have: (1) expanded on the literature associated with planning, programming, and budgeting systems (PPBS) [No. 3 and 10]; (2) provided a conceptual answer to what is PPB [No. 4 and 12]; (3) presented details on an operational system (DoD's) [No. 4 and 10]; (4) indicated how this system has evolved over time - particularly the Laird/Packard revisions [No. 10]; and (5) described the CAMPUS V resource simulation model [No. 5]. To fully appreciate and understand this report, the reader should be familiar with the contents of these other PRIME reports, particularly PRIME report No. 8.

The first section of this report will delve into the structuring process of PPB systems.1/ The section will emphasize the ideas, rules, and principles for structuring resource data that have evolved during the 10 years of PPB existence. Also the work by the WICHE-PMS group on a "Program Classification System" [Gulko, June 1970] will be addressed in detail.

The major problem in structuring resource data is converting it from its "traditional orientation" - organization, line-item (object of expenditure) - to a more goal-oriented, output-oriented format [McGilvery, 1966, 1968]. This conversion, called "Program Costing," is the major topic of the paper. Because of the amount of data manipulation required, it is desirable (in fact imperative) to utilize a computer. It is for this reason, plus the capability of the model to "simulate," that the paper develops Program Costing based on utilizing the CAMPUS V model.

When attempting program costing, a problem rapidly arises: What do we mean by an "output-oriented" format? The output-oriented format question is addressed by proposing a "program structure" that is compatible with the multi-uses of data coupled with a model that accepts "program-element" inputs. The multi uses of data are defined dichotomously by two management functions - planning and control.2/ The control function is carefully considered in proposing guidelines for developing a program structure. Essentially this involves minimizing the amount of allocation. The program elements of this structure then serve as input to a planning-oriented model that allows for varying amounts of allocation - depending on the planning task. This latter model, which is structured using the ideas of Input/Output analysis, is explained in [Project PRIME Report No. 13].

1/One of the six PPB processes. The other processes are analysis, informational, administrative, operating, and control [PRIME Reports 4 and 10].

2/For an excellent definition and discussion of these management functions see [Anthony, 1965].

THE STRUCTURING PROCESS

There are three important aspects in the structuring process of a PPB system. First, the structuring process involves determining an organization's goals and objectives. Secondly, the primary components of this process are the development, modification, and maintenance of a "program structure." Lastly, a "program structure" is a hierarchical grouping of an organization's activities and programs in a manner that indicates their relationship to the organization's goals and objectives.

DEVELOPING A PROGRAM STRUCTURE

Figure 1 presents a program structure for a School of Business Administration (SBA). The process of developing a program structure is very much of an art, and according to one expert may take several months:

> One could spend many months and even years trying to develop the 'perfect' program structure before implementation, but since a perfect program structure does not exist anyway, it is best to try to come up with something reasonably soon, get it into operation, and then let it evolve over time [Fisher, May 1966: 27].

Desirable features for a program structure include:1/

(1) a hierarchical classification scheme focusing on output or end products;

(2) a grouping of program elements in a manner suitable for analysis;

(3) inclusion of all activities of an organization, including provisions for planned or possible programs;

(4) a clear identification of the organization unit responsible for accomplishing the objective - however, the responsible unit is rarely a program;

(5) categorization of activities by multiple attributes (e.g., target population, geographic location, etc.);

(6) a clear distinction between primary and support objectives;

(7) major categories or programs that are reasonably stable and have an underlying principle or classification theme;

1/Primary inspiration for these desirable features are [DonVito, 1969], [Haggert, 1969], [State Local Finances Project, 1967, 68, 69]. Guidelines for developing program structures are also discussed in [Carlson, 1969], [Hinrichs and Taylor, 1969], [Tucker, 1966], [U.S. B.O.B., 1965, 67], [USDHEW, 1967], [VanWijk, 1969].

(8) program categories that are clearly distinguishable from budget categories - operations and maintenance is not a program;

(9) program elements that are a complete system and designed to develop, procure, and operate a program;

(10) a reflection of the decision-makers preferences and individuality.

With these ten desirable features in mind, there are two approaches to developing a structure: "prescriptive" - defining programs according to what programs the organization should be pursuing (top down approach); versus "descriptive" - identification of programs and objectives from present activities (bottom-up approach). According to RAND Corporation researchers:

> "In developing a program structure it is important to pursue both approaches and to try to bring them into agreement as much as possible. This means that the categorization process must be an iterative one. Each cycle will involve some regrouping of activities and restatement of objectives in order to reconcile mismatches. The final program structure and statement of objectives will take form only after the process has been repeated several times. Past experience with program budgeting has shown that this process is often valuable in itself, apart from the immediate objective of formulating a program structure, because of the incentive it provides for re-examination of established activities in relation to organizational goals." [Haggert, 1969: 27-8.]

Two strategies for implementation of a program structure are described by Benton and Tenzer as "revolution (distinguished by executive directives and imposition from the top), or evolution (characterized by extensive inter-organizational communications and involvement)" [Benton and Tenzer, 1969: 13]. Characteristics of a program-budget using these two approaches are shown on Figure 2.

THE WICHE-PMS PROGRAM CLASSIFICATION STRUCTURE

One of the primary efforts of the WICHE-PMS program has been the design and dissemination of a "Program Classification Structure" (PCS). According to the authors of the PCS - "The Program Classification Structure has been developed to provide a consistent means of identifying and organizing the activities of higher education in a program-oriented manner" [Gulko, June 1970: 1.1]. Later in the same publication, the author notes that:

> "The structure presented here is but one of many alternative structures that could be used for higher education program budgeting. Although it has been developed in a generalized manner to accommodate a wide variety of educational institutions, the Program Classification Structure is relatively consistent with the current program budgeting efforts of

some of the major institutions of higher education.1/ It is hoped, therefore, that the Program Classification Structure is sufficiently flexible to be used without extensive modification by institutions wishing to adopt a program budgeting system. To this end, it is intended that the program classification structure will facilitate the adaptation of program budgeting techniques in the management of higher education." [Gulko, June 1970: 1-5,6.]

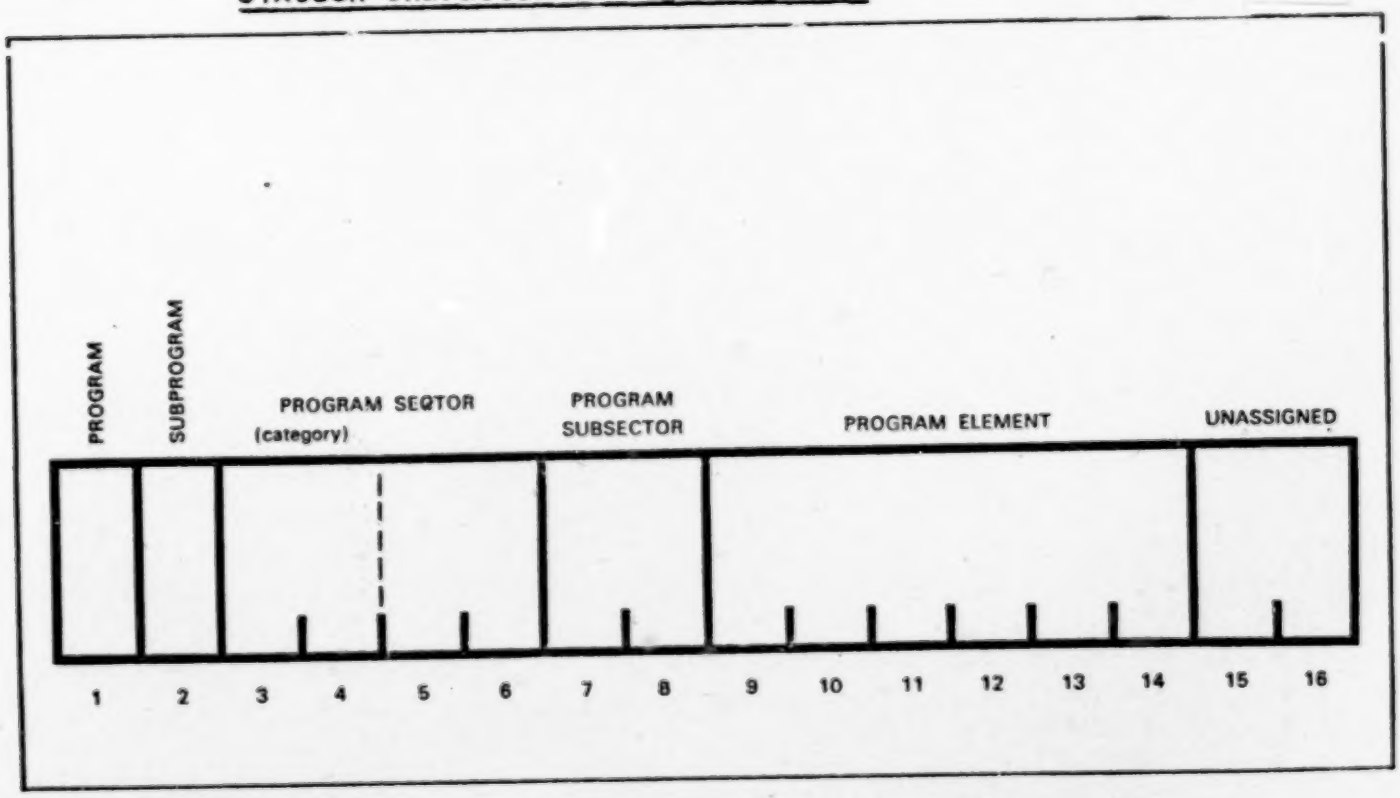
Program Classification System - Organization and Nomenclature

The "nomenclature" for the PCS is reproduced on Figure 3. Figure 4 is the "organization" of the PCS. Referring to Figure 3, we see that there are several levels of the PCS. Each level has a "name" (e.g. program sector), and an example (e.g. program sector - Physics). Figure 4 provides additional detail for the first 3 levels - primary/support; program; and subprograms. Below the sub-program level, WICHE-PMS proposes that:

Program Category = HEGIS Discipline
Program Sector = HEGIS Specialties
Program Subsector = Course level
Program Element - Course

The HEGIS Disciplines and Specialties are a Federally accepted procedure for categorizing academic programs [USOE, to be published]. The basic data element of the PCS is the "program element." Each program element consists of a 16 character code as follows:2/

Sixteen Character Coding Structure



1/"e.g. The University of California, the State University System of Florida, Ohio State University, University of Toronto" - Gulko's Footnote, p. 1-6.

2/Reproduced from [Gulko, June 1970: 2-9].

The "Program Classification Structure" - Is it a Program Structure?[1]

The PCS has been reviewed by representatives from 500 institutions and agencies concerned with management of higher education [Gulko, 1970]. This review process has been particularly helpful for many institutions who do not have sophisticated data systems, and furthered one of WICHE's prime objectives - establishment of standardized and compatible data elements.

Although the PCS contributions to higher education have been significant, it has been the cause of some confusion. The confusion revolves around the following questions: Is the PCS a "program" classification structure (i.e., a program structure), or is it a "data" classification structure. Unfortunately, in this author's opinion, the PCS is primarily the latter. Perhaps the best way to explain this distinction is with an example. Referring to Figure 1, we note that this "program structure" for a School of Business follows the PCS until it reaches the program sector. The next lowest level in this program structure is a degree program element. This should be contrasted with the PCS which goes two more levels - the course level (e.g., lower division) and the course itself. The course is called a "program element."

Whether a program element should be a course or a degree is a difficult question to answer definitively. First, we need a definition of a program element. Number (9) of the ten desirable features for a program structure hinted at a definition: "a complete system designed to develop, procure, and operate a program." The Federal definition mentions the following characteristics of program elements:

> (1) They should produce clearly definable outputs which are quantified wherever possible; (2) wherever feasible, the output of a program element should be an agency end product - not an intermediate product that supports another element; and (3) the inputs of a program element should vary with changes in the level of outputs, but not necessarily proportionally. [Carlson, 1969: 641.][2]

While this latter definition does not absolutely establish the case for degrees as program elements, characteristic (2) does strongly support it. Also it is this author's opinion that a degree is a more representative measure of institution output (characteristic 1) than a course.

A second consideration is that using degrees will reduce the number of program elements to a more manageable number. Recall that the Department of Defense (DoD) with a $75 Billion budget has approximately 1100 program elements; and based on the author's personal experience in DoD, there were only a very small number of people who

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[1] What follows could be interpreted as a criticism of the PCS. It is not. The primary purpose is to suggest why the "degree oriented" program structure to be used in the remainder of this study is more appropriate for resource analysis than the "course-oriented" structure proposed by WICHE-PMS.

[2] Underline added.

could cope with this level of detail. For a University of any size, using courses as program elements, would result in thousands of elements.1/

The third consideration in comparing a degree-oriented with a course-oriented program structure is the confusion that exists between a "discipline instruction program" and "the degree program." The author of the PCS is aware of this confusion:

> "Often the program concept is clouded in its application to academic instructional programs because of the dual nature of the instruction-producing activities. For example, all course offerings in physics comprise the physics discipline instruction program; whereas physics majors may take some courses in physics, some in mathematics, etc., to constitute a degree program in physics.2/ Thus, the components of an instructional program may be reviewed in terms of their contribution within the discipline. Nevertheless, the distinction between instructional program cost and degree program cost is fundamental and must be kept clear and explicit:
>
> a. The discipline instruction program is concerned with the instruction activities in a specific field of knowledge, i.e., discipline as defined by the HEGIS Taxonomy.
>
> b. The degree program is concerned with the instruction activities in which a student engages in the pursuit of a degree or certificate, i.e., the curricula mixes which lead to the award of a specific degree." [Gulko, June 1970: 1-15.]

If you accept that WICHE-PMS understands that their PCS has "clouded" the program concept, why do they not change? The answer involves understanding the concept of an "induced course-load matrix." Figure 5 is an example of an induced course-load matrix. Referring to the figure, the rows represent the organization of the school's instructional program into discipline divisions and discipline specialties (typically, academic organization will follow these divisions and specialties) whereas the columns are student levels (i.e., 1 = lower division, 2 = upper division, etc.). The numbers in the matrix are "average credit hours per student." Gulko assumes that the "induced course-load matrix is developed and maintained apart from, but in a manner compatible with, the Program Classification Structure? [Gulko, June 1970: 1-19]. To determine the degree cost, it is a relatively simple matter to multiply the induced course-load matrix times the average cost-per-credit by discipline and specialty [Gulko, Jan., 1971b].

The crux of the reason that WICHE-PMS doesn't change to a degree

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1/The University of Minnesota has approximately 10,000 courses.

2/The dual use of "degree" program and "discipline instruction" program is confusing. Underline added by present author.

oriented PCS can now be seen by contemplating the induced course-load matrix. Obviously from institution to institution the degree requirements are not standard or compatible. Since a key objective of the WICHE-PMS program is data exchange and standardization, a compatible classification structure was needed; but that is not possible with a degree-oriented program structure. As a compromise, they selected a course-oriented data classification system and developed a model to handle the degree calculations [Gulko, Jan. 1971]. The compromise was probably essential, but has caused confusion.

The Program Classification System - A Summary:

The basic issue in the preceding discussion is whether the grouping of an institution's activities (particularly those related to instruction) into discipline divisions and discipline specialties is a more appropriate "output-oriented" format than grouping the activities by degrees. Considerations presented in favor of the degree-oriented structure included: (1) it is more representative of an agency's end product (as opposed to intermediate products); (2) fewer program elements; and (3) it does not confuse the organizational units (divisions and departments) that are responsible for accomplishing the objectives with the objective itself - the degree.[2/]

Although the author feels strongly that the PCS should more appropriately be called a "data" classification structure, the program and subprogram levels of the PCS are excellent. Figure 4 includes a complete listing of these two levels.

A degree-oriented program structure would take Level 3 program category which is now the HEGIS discipline "division", and use the label to represent a categorization or summarization of degrees rather than instructional programs. Referring to Figure 1, the program category - Business and Management - would be the sum of the "degree costs" for all those HEGIS discipline "specialties" associated with Business and Management (e.g. Accounting, Finance, etc.). Each program sector (labelled with the HEGIS discipline "specialty" code) would be the sum of each degree offered (sponsored) by this specialty (department). Referring again to Figure 1 the Accounting Department (i.e., the HEGIS Accounting discipline "specialty" (502) offers three degrees - Bachelor of Science Business (Accounting), Master of Science (Accounting) and Doctor of Philosophy (Accounting). These three degrees represent program elements.

1/Note: not "less data available in data base".

2/Of course, the degree is nothing more than an indicator of the true output - an educated student [Larence, July 1970].

PROGRAM COSTING AND THE CAMPUS MODEL: BACKGROUND

Program costing is a technique or procedure for converting resource data from organization, line-item detail to a goal-oriented, output-oriented format. In the previous section, we discussed some of the "desirable features" of an output-oriented format; and we also explored the pros and cons of a "degree" versus "course" oriented structure for higher education. The purpose of this section is to explain the "mechanics" of conversion within the context of the CAMPUS model.

Before we can discuss mechanics, there are several key assumptions guiding development of the "program costing module" for CAMPUS.

PROGRAM COSTING AND CAMPUS: A PHILOSOPHIC NOTE

This section will provide some of the basic assumptions guiding development of a "Program Costing Module" for the CAMPUS simulation model. Any conversion routine or procedure attempting program costing must consider:

(a) flexibility in defining (1) program elements (e.g. degrees) (2) organizational entities (e.g. departments), and (3) budget line items (e.g. supplies);

(b) the multiple uses of resource data;

(c) what the resources in the system represent (e.g. "approved" resources versus "required" resources) and

(d) the varying amounts of allocation that are possible and/or desirable.

Requirement "a" is handled nicely by the present CAMPUS model as explained in [Project PRIME Report No. 8].

Although "usage", consideration "b" is only one way of structuring data, in the author's opinion it is the most useful [Head, September 1970]. This approach, however, assumes the existence of an integrated management system. PPBS can be thought of as such an integrated management system and as a useful starting point for determining the multiple uses of resource data. Figure 6 schematically portrays some of the important processes necessary in an integrated management system.

The schematic draws heavily on three sources for its inspiration; (1) [Anthony, 1965]; (2) [Steiner, 1970]; and (3) the definitions of PPB espoused in PRIME Reports 4 and 10. Looking closely at the Figure we see that 5 of the 6 processes associated with PPB appear explicitly - structuring, analysis, information, operating, and control. The sixth process, the "administrative" process, is not shown explicitly, but may be thought of as the procedures for insuring the

other processes are functioning.[1/] The remaining four boxes represent various phases of the planning and control process (i.e., strategic planning, medium range programming, budgeting, and operation planning).[2/]

We can combine the multiple uses for data as schematically portrayed on Figure 6 with recognition of "what the resources in the system represent" (consideration c) into the following sketch:

		Resources Represent	
		Required	Approved
Management Use of Data	Planning	Resources and Benefit Analysis	Baseline Plan
	Control	Comparing Actual Resources with Planned	Standards Used in Control Functions

When the usage of resource data involves "planning" (Row 1), our primary concern is determination of the required resources for various alternative approaches to accomplishing the organization's goals and objectives. Note that resource analysis is only part of this analysis process - determining the benefits or effectiveness of the proposed alternatives is also necessary. Results from the planning-analysis process are presented to the decision-maker(s) who then selects a course of action or an "approved" plan. In PPBS this approved or "baseline" plan is called the program and financial plan (PFP).

[1/] The DoD's administrative process includes "the calendar" program memoranda, program change procedures, and "agency head support" [PRIME No. 4 and 10].

[2/] [Anthony, 1965] and [Steiner, 1970] discuss these phases in detail.

When the usage of resource data involves "control" (Row 2 in the sketch above), our primary concern is comparing actual resources consummed in the operating process with the planned consumption. Significant deviation of actual from standard will trigger two responses--action to correct the situation and feedback into the planning processes to re-access the standard (or approved resources).

Obviously our 2 x 2 matrix doesn't represent all the possibilities, but it will serve as a useful reminder when we face the perplexing problem of allocation.

PROGRAM COSTING AND CAMPUS - HOW MUCH ALLOCATION?

A plaguing problem in program costing concerns procedures for allocation of various indirect costs. Part of the problem is a lack of cost standards, i.e. "An agreed -on definition of cost that is applicable to a number of situations [Anthony, 1970: 122].[1/] In a recent article, Anthony indicates that what is needed is a conceptual foundation that spells out in broad terms answers to two questions;

(1) What are the total costs incurred by an organization in an accounting period?

(2) How should this total be divided among the several cost objectives of that period? [Anthony, 1970: 126].

According to Anthony, an "authoritative source"[2/] provides this rough approach to answering question 2:

- costs are divided into direct costs and indirect costs;
- direct costs are assigned to cost objectives; and
- each cost objective is assigned a 'fair share' of the indirect costs [Anthony, 1970: 126].

The third step (handling the indirect costs) opens the question of allocation. Anthony's proposal is as follows:

> If those responsible cannot come up with a better approach (and I doubt that they can), they will presumably use the foundation that is already familiar to cost accountants: costs are initially collected in relatively homogeneous pools, and the total of each of these pools is then divided among the cost objectives on some equitable basis. So there needs to be one set of criteria for

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1/It is interesting that WICHE-PMS has also formed a "cost finding principles" task force.

2/Authoritative Source is the Armed Services Procurement Regulations.

specifying what is meant by a 'homogeneous pool' and another set for deciding among the possible ways of allocating the total of each pool to cost objectives" [Anthony, 1970: 127].

Using Anthony's suggestion on allocation as a starting point, the following approach to program costing will be followed.

Step 1 - Develop procedures and criteria for finding a baseline plan (i.e. a program and financial plan, using the "homogeneous pool" concept) but still structure the data, to the extent possible, in an output-oriented manner, (i.e., in a program structure). The homogeneous pools of resources represent certain types of budgetary line items that cannot be converted to program elements without (1) losing their organizational identity, (2) losing the ability to completely reconstruct the resource in a parametric manner, or (3) losing "General agreement" about the procedure for allocation.

Step 2 - Utilize the program elements in the above special program structure to serve as input to a "model" that has the capability to rapidly do the allocation needed for resource analysis of various alternatives. Once the planner/analyst has completed his evaluation of alternatives, the model still maintains the ability to return to the "approved" or "baseline" program structure. Project PRIME Report Number 13 discusses the "model" that accepts program element input, but allows allocation for planning and analysis.

Activities that are classed as "semi-variable" or semi-fixed" present the major problems in developing procedures and criteria needed in Step 1 of program costing because (1) "strictly variable" costs will be pro-rated (based on a consistent, published procedure) to the primary program elements, and (2) "fixed costs" will be maintained in specified support program elements, with no attempt to pro-rate them to the primary or direct program elements.[1/]

Two criteria guide the handling of semi-variable costs. First, semi-variable costs should not be allocated to primary program elements unless organizational integrity can be maintained.[2/] The second criterion is concerned with the location in the program structure of these semi-variable program elements - their location in the program structure should be predicated on the activities "primary intent." If the primary intent is for one program, the semi-variable program element should be included with that program. Perhaps an example will explain this concept. Say an academic department has a

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[1/] However, both "strictly variable" (e.g. cost of academic staff contact hours) and "fixed" costs (e.g. Dean's salary) may be allocated differently for analysis purposes.

[2/] This is compatible with the Federal Government Guidelines in handling support and indirect activities [U.S. BoB, 1968] and with an improved PPB System proposed to the Federal Government by [McKinsey and Co., 1969].

"tutorial service" available. It may be difficult to agree on a basis for assigning the resources associated with these personnel to program elements; however, clearly this service exists because of the instruction "program". Therefore, a program element called "tutorial service" should be created and included in the instruction program. For answering questions about "degree" or instruction costs (an analysis question) these costs could be allocated.

Another question handled by the "primary intent" philosophy is the case where a semi-variable activity applies to more than one program. A program element for these activities should be created in an appropriate support program. An example of this kind of activity is "department administration", since it related to all three primary programs (e.g. instruction, research, and public service). Departmental Administration is shown as a program element in the Academic Support Program shown on Figure 1.

PROGRAM COSTING AND THE CAMPUS MODEL: THE MECHANICS[1/]

This section will explore program costing in the context of the CAMPUS model. Recall that our objective here is to develop the "approved" or "baseline" resources in a program oriented fashion (i.e. to determine resources for the program and financial plan). The version of CAMPUS available to the public, CAMPUS V, has all of the elemental data needed to develop these resources; however, no computer coding has been provided to convert these elemental data into program reports.

The proposed approach to program costing will be discussed in four sections entitled: (1) Service Department Process; (2) Activity/curriculum Process; (3) Non-teaching Duty Process; and (4) Academic Indirect Resources.[2/] Figure 7 indicates which process is typically used forhandling the various programs.

THE SERVICE DEPARTMENT PROCESS

Referring to Figure 7, we note that there are three support programs-academic, student, and institutional. Developing resource information for program elements in these categories will normally involve using the "Service Department Process".

The Service Department Process used in program costing is schematically portrayed on Figure 8. As noted on the Figure, there are several key concepts -

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1/Making "program costing" a reality on the CDC 6600 was accomplished primarily by Pat Davitt and Ray Pinson, with support from Sam Fisher and Ed Hwang. Many valuable comments and suggestions were supplied by Gary Andrew and Al Lorents.

2/Project PRIME Report Number 8 discusses each of these processes as they presently exist in the CAMPUS V model.

(1) Each Service Department (SD) is "assigned" (i.e., receives resources from and is controlled by only one cost center or department).

(2) Each SD supplies resources to only one program element (e.g. is "aligned with it). However, the requirement for resources at any SD may be determined by the level of activity at many "Affiliated" program elements. The "vehicle" for transferring level of activity into resources at the SD is the proportional basis.[1]

(3) Each program element may receive resources from many service departments (each of these DS's would however have been assigned to this one program element).

(4) Each Cost Center may supply resources to many service departments.

In summary - A service department is a unique organization or department with only one "boss" (Cost Center) and is displayed in the program structures only one element (its primary intent). However, the department's required resources depends on the level of activity at several "affiliated" program elements.

When using the service department process in CAMPUS, we are dealing with either "fixed" or "semi-variable" activities. These activities are specific, identifiable departments. In the traditional hierarchical organization structure, each entity (Service Department) has only one "boss." This is the rationale for the "assignment" of each service department to a cost center.

The "alignment" of a service department to only one program element is needed to provide an "audit trail" from resources in a program element back to the appropriate supplier of that resource - i.e. the cost center. As noted previously, if a service department, or "homogeneous pool" of resources, is split or allocated, the "Audit trail" will be lost because either (1) the service department will lose its organizational identity, or (2) the resulting allocation can't be reconstructed in a parametric manner.

"Affiliation" with several program elements is desirable for service departments which are "semi-variable" (i.e. their expenditures or resources consist of a fixed portion and a variable portion). For example, analysis of the number of keypunch operators needed in the computers service department in the past has been a minimum of two, plus one additional operator for each 1000 students. The "fixed" portion in the future could be assumed to continue as two, with the variable operators a function of the students in affiliated degree program elements.

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[1]/Explained in Project PRIME Report 8.

The combination of "assigning" a SD to a cost center, "aligning" a SD with a program element, and "affiliating" a SD with a group of program elements can be thought of as a definition of a service department.

The present model has two "cost center" reports for service departments.[1] Based on the ideas presented above, two similar "program" reports were developed.[2]

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[1] Project PRIME 2 describes the present CAMPUS outputs.

[2] Appendix A includes a copy of all program reports.

THE ACTIVITY/CURRICULUM PROCESS:[1]

Converting "direct costs," i.e. the six resource types affixed to each activity, to program elements is not conceptually difficult since in the present CAMPUS model each activity (course) is "assigned" to a cost center from which it receives its resources and since each activity is "affiliated" and "aligned" with program elements through participation rates and a curriculum structure.[2] The only practical difficulty in the process is deciding upon which "basis" to convert or transfer resources from a cost center to a program element.

One approach to this conversion is on the basis of enrollees per activity by program elements. Schematically:

What the schematic says in words is: first, determine the direct resources required for an activity; then divide the total direct cost by the number of enrollees in the course; and lastly, transfer the direct cost to each program element (degree) - based on the enrollees in the course. Note that we would have arrived at the same direct cost per program element if we had used student contact hours or student credit hours.

With the basic unit being resources per activity six direct cost program reports were designed. A copy and a description of each of these reports in included in Appendix A.

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[1] Project PRIME Report No. 8 discusses these 6 resources, i.e., academic staff, academic support staff, classroom space, instructional laboratory space, special laboratory space and teaching equipment.

[2] Project PRIME Report No. 8 discusses "participation rates" and the "curriculum structure".

NON-TEACHING DUTY PROCESS

The present version of CAMPUS has a non-teaching duty (NTD) process, for academic staff only, that uses the concept of a proportional basis to develop the "staffing units" for non-teaching duties. Non-teaching duties are included in the CAMPUS model to handle individual faculty activities (e.g. departmental research, professional development, etc.). The creation of a unique program element seems an appropriate means of handling the conversion. This seems justified since these activities represent outputs (although some are obviously "intermediate" outputs) and are similar to the homogeneous pools discussed above.[1/]

ACADEMIC INDIRECT RESOURCES PROCESS:

In the present CAMPUS-V model there are three categories of resources available only to "academic" cost centers that should, in the author's opinion, be allocated to the instruction program element. These categories are -

(1) NON-ACADEMIC SUPPORT - designed to provide secretaries, graders, research assistants, etc.

(2) ACADEMIC MISCELLANEOUS RESOURCES - Examples of academic miscellaneous resources include supplies, benefits, hiring expenses, etc.

(3) ACADEMIC OFFICE SPACE MAINTENANCE COST - Each academic staff, academic support staff, and non-academic support staff have an assigned office space.

Conversion of these three categories of resources into program elements is a two step procedure. Step 1 involves developing the requirements for these three categories of indirect resources. The first two categories involve using the functional basis concept. The third category, office space maintenance cost, is developed nicely in the present model, since it is "tied" directly to the Staff, and Non-Academic Staff (all by rank). The purpose of Step 2 is to "convert" these indirect reousrces from the cost center to "appropriate" program elements. There are two reasonable conversion routines -

(1) Using a unit allocation rule for each indirect resource, or

(2) Using the academic staffing unit.

[1/] The essential point is that allocation of these individual faculty activities is best left to the analysis process.

The unit allocation procedure would convert each indirect resource (by cost center) to the appropriate program element, based on a % of one of the following (at the appropriate program elements):

(a) direct resources; (b) students; or (c) enrollees.

The academic staffing unit procedure is a unit allocation rule with the only basis for conversion being one type of direct resource academic staffing units. It is the author's opinion that the latter procedure for converting these indirect resources into program elements is the preferred. Rationale for this opinion is as follows: (1) some of the program elements receiving these categories of resources contain only academic staffing units (those that contain only individual faculty activities e.g. faculty public service, professional development); (2) most of these indirect resources are a strong function of faculty staffing units; and (3) the procedure is simple and easy to understand.

Based on this latter allocation rule, a series of program reports were developed indicating the amount of indirect academic resources required for each program element [Program Reports 6.1 - 6.6, Appendix A].

PROGRAM COSTING AND CAMPUS: SUMMARY

The previous section described four procedures to handle the conversion of resources from the CAMPUS V model, where the resources are developed for departments to an output-oriented format. These four processes were -

(1) Service Department Process. A set of procedures to handle the Staff, Space, and Equipment expenditures associated with the support programs.

(2) Activity/curriculum Process. A conversion routine to handle the 6 types of "direct cost" resources: (a) Academic Staff; (b) Academic Support Staff; (c) Classroom and maintenance cost; (d) Lab space and maintenance cost; (e) Special Lab space, maintenance cost, and equipment operating cost; and (f) Teaching equipment cost.

(3) Non-teaching Duty Process. A set of rules for converting faculty non-teaching duties, including individual and sponsored, to program elements.

(4) Academic Indirect Resources Process: An allocation technique for three types of "academic" indirect resources: non-academic support (e.g. secretaries); miscellaneous resources (e.g. supplies); and office space maintenance cost.

The individual application of these four processes to the CAMPUS V model results in a series of program-oriented reports. If all four processes are applied, a series of summary reports (7.1 - 7.3) are available. A sample format for each of the 27 program reports can

be found in Appendix A. Figure 9 includes the name of each report.

For each program element, it is possible to receive many of the above reports for 10 years, by quarter. Typically a manager would not want to look at this number of reports. To redress this situation, a series of "program" overtime reports were developed. These reports summarize various operating costs, by year, for a ten year period.

All of the above reports are based on a program structure that has very little allocation - since there are many homogeneous pools, including individual faculty activities (Non-teaching duties) and some of the service departments. For analysis these pools may need to be allocated. A "model" is needed that accepts program element input and has the capability to rapidly do the allocations needed for analysis. This is the subject of Project PRIME Report 13.

Figure 1

Illustrative Program Structure
for a
School of Business Administration

PRIMARY

1.0 INSTRUCTION
- 1.1 Undergraduate
  - BSB Accting
  - BSB Regular
- 1.2 Graduate
  - Master of Business Administration (Day)
  - Executive Master of Business Administration (Evening)
  - Master of Arts - Industrial Relations
  - Ph.D. - (10 program elements)[1/]
  - Master of Science - (10 program elements)[1/]

2.0 RESEARCH
- 2.1 Organized Research
  - Center for Experimental Study of Business (CESB)
  - Industrial Relations Center (IRC)
  - Management Information Systems Research Center (MISRC)
- 2.2 Department Research
  - Summer Research
  - Department Research

3.0 PUBLIC SERVICE
- Continuing Business Education
- Bureau of Business Research
- Faculty Public Service

SUPPORT

4.0 ACADEMIC SUPPORT
- Computer Center
- Industrial Relations Library
- Business Reference Library
- Department Administration and Committees
- Professional Development

5.0 STUDENT SUPPORT
- Pre-Business Counseling
- Graduate Studies
- Placement
- Student Support - Faculty

6.0 INSTITUTION SUPPORT
- College Administration
- Administrative Services
- Committees - College Wide

[1/] Each element is a degree major: Accounting, Finance, Industrial Relations, Management, Management Information Systems, Marketing, Production, Quantitative Analysis, Insurance, and Transportation.

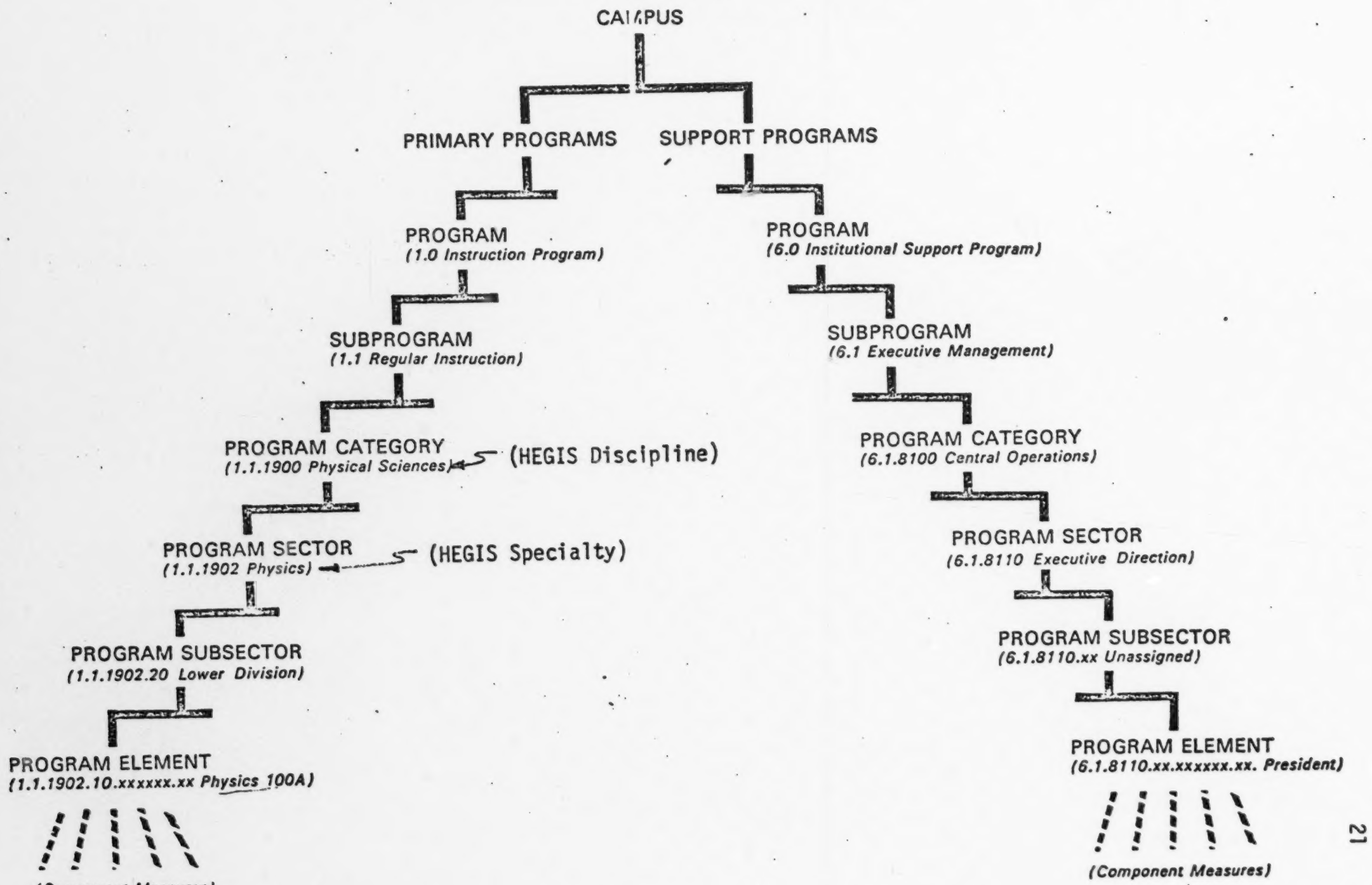
Figure 2
Characteristics of a Program Structure
Revolutionary versus Evolutionary Implementation *

PROGRAM BUDGET I (Revolutionary)	PROGRAM BUDGET II (Evolutionary)
A. Organization is made to conform to the demands of systems analysis.	A'. Systems analysis is made to conform to the unique characteristics of the organization.
B. Top management and outside consultants develop the program-budget structure.	B'. The program-budget staff and the organizational subsystems collaborate in the development of the program-budget structure.
C. The organization's acceptance of the program budget is based on executive power.	C'. Organizational acceptance is based on compromise, iteration, feedback, and two-way communication.
D. Immediate redefinition of organizational objectives (based on the strategies of the "formal" organization) for different product designs, anticipated trends in the market, constituent demands of the future, current research, and outside sources of information.	D'. Gradual modification of organizational objectives in terms of currently perceived objectives with extensive participation of organizational subsystems in addition to external research and information. Development of new objectives occurs through two-way communication. Informal groups have some influence on goal definition.
E. Major programs and subprograms in the program-budget format are linked to the newly defined objectives.	E'. Major programs and subprograms are linked to the organizational chart and the current operating procedures of the organization.
F. Process carried out essentially through executive d rectives.	F'. Process based on feedback between the program-budget staff and the organizational subsystems.
G. Program budget is essentially a product of top management and is understood only by top management.	G'. Program budget is essentially a product of total interaction, and as many viewpoints as possible are represented.

*[Benton and Tenzer, 1969: 13-14]

Figure 3

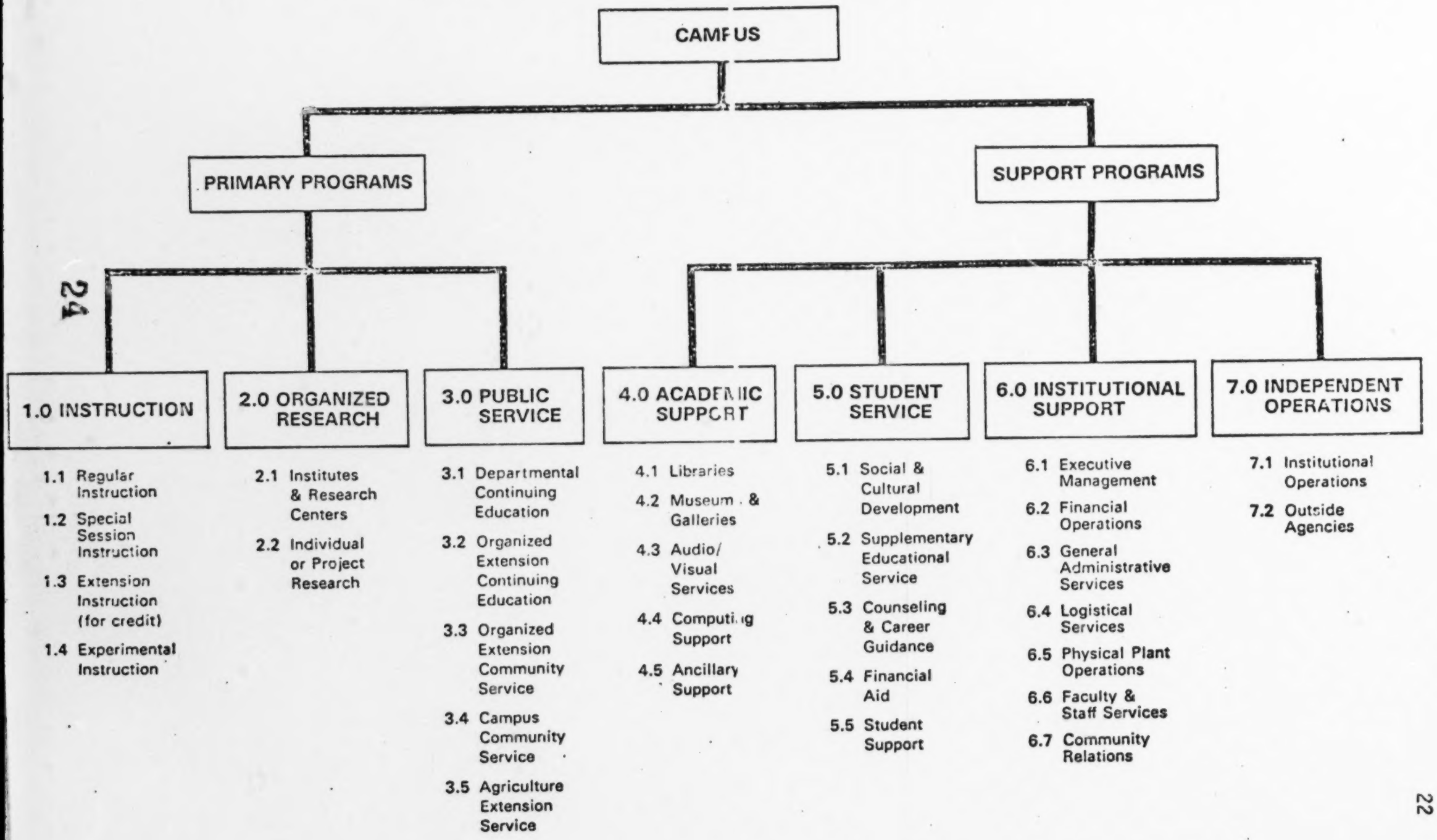
Program Classification Structure Nomenclature*



*Reproduced from [Gulko, June 1970: 2-2]

Figure 4

Organization of the Program Classification Structure



[Gulko, June 1970: 2-18]

Figure 5

Induced Course Load Matrix*

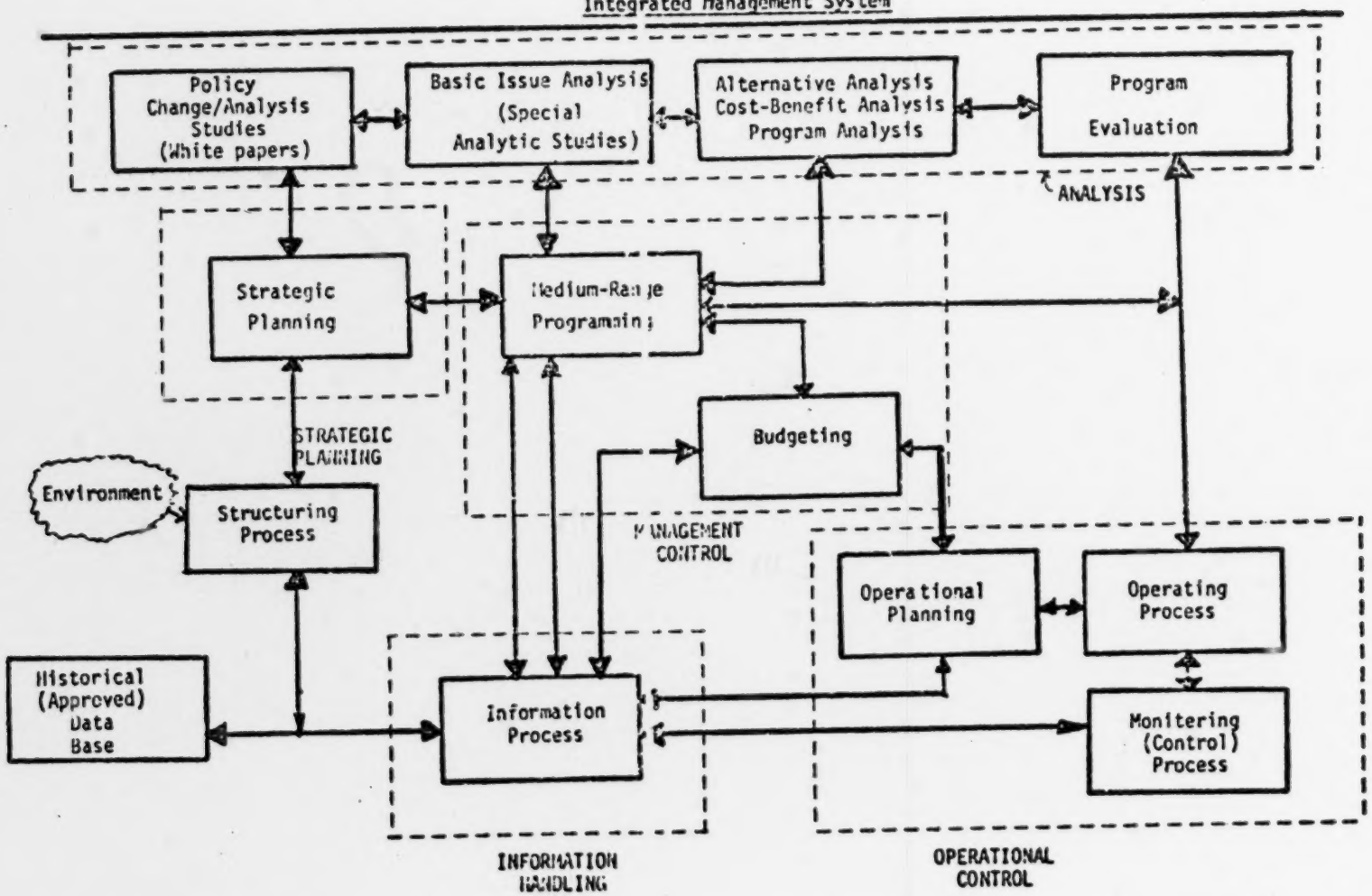
Disciplines / Degree by student level		Degree Type 1				Degree Type 2				.....	Degree Type n			
		Student Level				Student Level					Student Level			
		1	2	3	4	1	2	3	4		1	2	3	4
Division 1 Business and Management (0500)	Specialty - Accounting (0501) Specialty - Statistics (0503) . . Specialty - Business Economics (0517)													
Division 2 Letters (1500)	Specialty - English (1501) Specialty - Literature (1502) . . Specialty - Philosophy (1509)													
Division 3 .	Specialty													
.	.													
.	.													
.	.													

Average Credits per Student per Quarter

*Modified from a table in [Gulko, 1971b: 16]

Figure 6

A Conceptual Model of an Integrated Management System*



*See text for references.

Figure 7

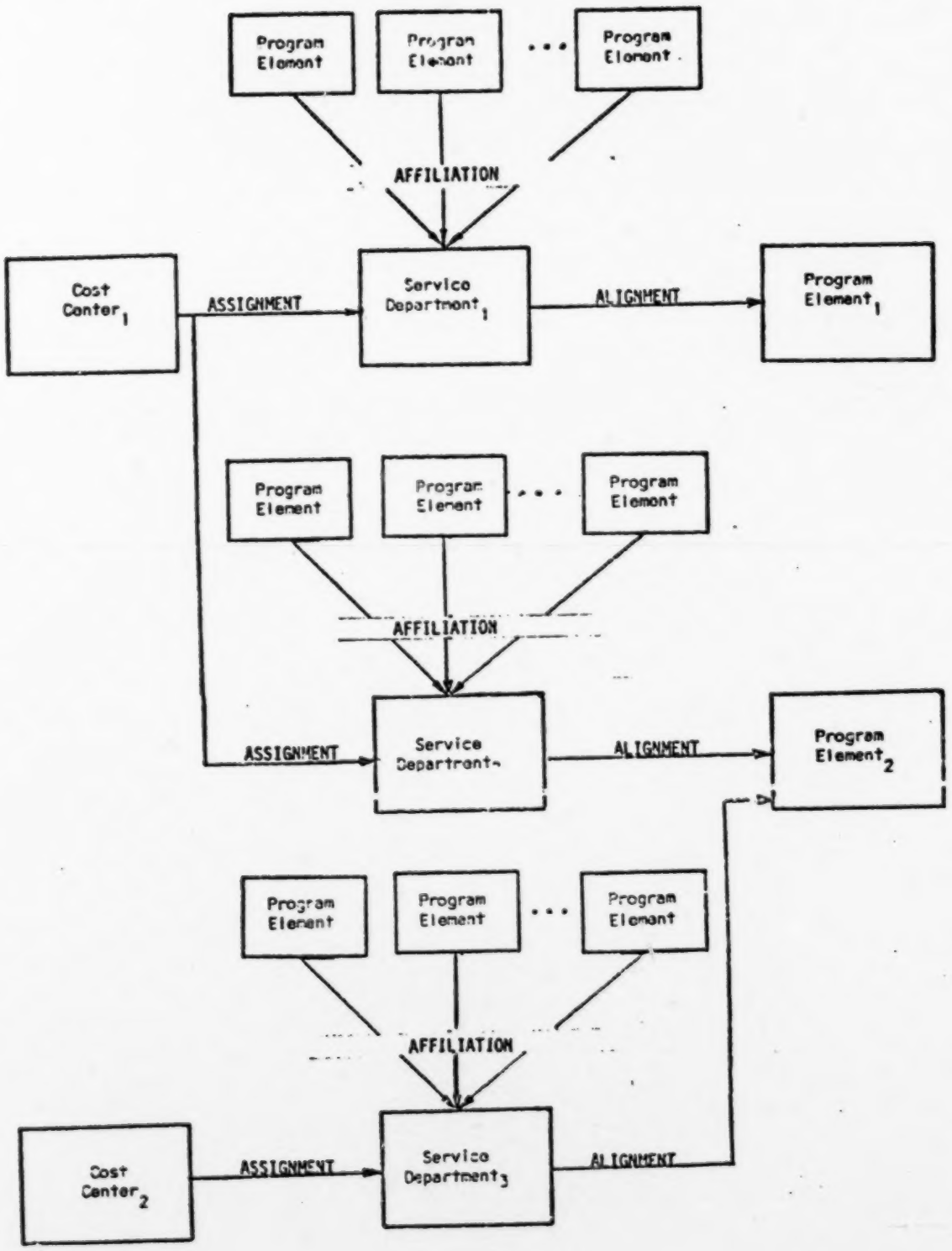
Program Costing and CAMPUS*

Typical Program Structure	CAMPUS Process
INSTRUCTION	Activity/Curriculum
RESEARCH	
Sponsored	Service Department Non-teaching duty
Department	
PUBLIC SERVICE	
Specific Organization	Service Department Non-teaching duty
Faculty Public Service	
ACADEMIC SUPPORT	
Department Administration and Committees	Non-teaching Duty
Specific Organization	Service Department Non-teaching Duty
Professional Development	
STUDENT SUPPORT	
Specific Organization	Service Department Non-teaching Duty
Faculty Student Support	
INSTITUTIONAL SUPPORT	
Specific Organization	Service Department Non-teaching Duty
Faculty Institutional Support	

*Figure 1 included a sample program structure.

Figure 8

SERVICE DEPARTMENT PROCESS



Key Concepts:

(1) Each service department is "assigned to" only one cost center.
(2) Each service department is "aligned with" only one Program Element. (However its demand may be determined by the level of activity at many "affiliated" Program Elements.)
(3) Each Program Element may receive resources from many service departments.
(4) Each Cost Center may supply resources to many service departments.

Figure 9

Program Costing Reports*/

PROGRAM REPORT NO.	DESCRIPTION
1.0 Cost Center Orientation (Direct Costs)	
1.1	Direct Cost by Activity (Dollars)
1.2	Direct Cost - by Course Level (Dollars)
1.3	Direct Cost by Cost Center Summary
1.4	Direct Cost by Coruse Level All Cost Centers
2.0 Program Orientation (Direct Costs)	
2.1	Direct Cost by Program/Cost Center/ Activity (Dollars)
2.2	Direct Cost by Program/Cost Center (Dollars)
2.3	Direct Cost by Program - Summary (Dollars)
2.4	Direct Cost by Student Level (Dollars)
2.5	Direct Cost by Student Level All Cost Centers
2.6	Direct Cost - by Budget Category
3.0 Program Report (Enrollees)	
3.1	Enrollees by Program/Cost Center/ Activity
3.2	Enrollees by Program/Cost Center
3.3	Enrollees by Program - Summary
4.0 Service Departments	
4.1	Service Department Report - by Program
4.2	Service Department Report - by Program Summary
5.0 Faculty Activities	
5.1	Non-Teaching Duty - Individual Faculty Activity

*/Appendix B includes a copy of each of these reports.

Figure 9
(Con't)

PROGRAM REPORT NO.	DESCRIPTION
6.0 Academic Indirect Resources	
6.1	Academic Indirect Resources - Detail
6.2	Academic Indirect Resources - By Type
6.3	Academic Indirect Resources - by cost center
6.4	Academic Indirect Resources - by Type and Cost Center
6.5	Academic Indirect Resources - Summary by Cost Center
6.6	Academic Indirect Resources - Summary by Programs
7.0 Total Operating Costs	
7.1	Total Operating Cost - by Program Element (Detail)
7.2	Total Operating Cost - By Program Element
7.3	Total Operating Cost - Summary All Programs

OVERTIME REPORT NO.*	DESCRIPTION
2.1	Students and Enrollee Load
2.2	Direct Costs and Indicators
2.3	Total Operating Cost by Program
2.4	Total Operating Cost - All Programs

*Have not been programmed at time of writing this report (June 1971).

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Project PRIME Reports

Report Number	Description	Author
1	Test Implementation of CAMPUS (A Computer Based Simulation Model) for Higher Education Administration and Planning in Minnesota, March 1970.	Andrew, Cordes Lorents
2	An Introduction to Project PRIME and CAMPUS-MINNESOTA, November 17, 1970.	Cordes
3	PPBS in Higher Education: An Annotated Bibliography, May 1971.	Cordes
4.	PPBS in Education: Concept, Operation, Status, and a School of Business Administration Example.	Cordes
5.	Program Costing with the CAMPUS Simulation Model, June 1971.	Cordes
6.	Faculty Activity Analysis and Planning Models in Higher Education, June 1971.	Lorents
7.	A Faculty Activity Information Subsystems and CAMPUS-MINNESOTA. June 1971.	Lorents
8.	Operational Overview of the CAMPUS Simulation Model, June 1971.	Cordes
9.	Using a Planning Model in Higher Education, (in progress).	Fisher
10.	Resource Analysis Models in Higher Education: a Synthesis (in progress).	Cordes
11.	Converting CAMPUS V to CAMPUS-MINNESOTA (in progress).	Davitt
12.	CAMPUS-MINNESOTA User Information Manual, June 1971.	Andrew
13.	Applying Input/Output Analysis and the EL FYD Model to Higher Education (in progress).	Cordes
14.	Mid-Year Progress Report, January 1971.	Andrew, Cordes, Lorents
15.	Case Studies of Resource Simulation in Education (A High School; A Junior College; A State College and two Schools of a Large University, (in progress).	
16.	Final Report of Project PRIME (in progress).	Andrew, Cordes, Lorents